1. Introduction

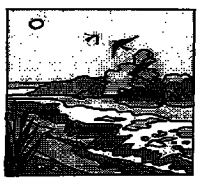
The Sacramento-San Joaquin Delta (Delta) is an area of regional and national importance. Delta levees are the most visible constructed features of the system. The levees are an integral part of the Delta landscape and are critical to preserving and improving the Delta's physical characteristics and processes, including definition of the Delta waterways and islands. To achieve objectives of the Delta Levee System Integrity Program (Levee Program) and other CALFED Bay-Delta Program (CALFED) objectives, in addition to meeting CALFED'S Solution Principles, the Delta levee system must remain generally in its current configuration.

Levees are critical to preserving and improving the Delta's physical characteristics and processes, including definition of the Delta waterways and islands. Many levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect.

Although the Delta levee system provides a broad array of benefits, many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. The benefits of an improved Delta levee system include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and conveyance benefits. The wide range of Levee Program beneficiaries include Delta local agencies; landowners; farmers; boaters; wildlife; and operators of railroads, state highways, utilities, and water distribution facilities. Delta water users and exporters also benefit from increased protection to water quality. The federal government benefits from improvements to navigation, commerce, conveyance, and the environment and from reduced flood damage.

The vulnerability of the Delta levee system to failure, especially during earthquakes or periods of high runoff, is a common concern. A levee failure in the central or western Delta would not only flood farmland and habitat but also could disrupt or interrupt water supply deliveries to urban and agricultural users, transportation, and the regional flow of goods and services. Even if the infra-structure and facilities survived the initial effects of inundation, long-term or permanent inundation would result in maintenance and repair being difficult, if not impossible. If a flooded island is not repaired and pumped out, the resulting body of open water may expose adjacent islands to increased wave action and additional subsurface seepage.

Of particular concern is the situation in which a levee fails in a dry or critically dry water year and one or more key western or central Delta island floods. Under these circumstances, inundation would allow salinity to intrude further upstream into the Delta. In-Delta and export water quality, along with the delicate balance of the brackish water habitat, would be negatively affected. The salinity intrusion could result in water supply interruption for in-Delta and export use by both urban and agricultural users, until the saltwater could be flushed from the Delta. In order to lower salinity in the Delta to acceptable levels and restore ecological balance, flushing flows would need to be released from upstream reservoirs. As



a result, water supplies in these reservoirs could be seriously depleted, and the ability to respond to other demands would be diminished.

The above hypothetical situation has a historical counterpart. In the early morning hours of a summer day in 1972, the southern levee protecting Andrus Island gave way. Rushing water poured through the initial break, quickly widened the opening to 300 feet, and eventually to 500 feet. Within 2 hours, Highway 12 was flooded and water began spilling over into the adjacent Brannan Island. During the next 2 days, Andrus and Brannan Islands were flooded with 164,000 acre-feet of water. Federal, state, and local emergency efforts failed to protect the town of Isleton. The water that flooded these islands was not winter floodwater from the major rivers that drain the watershed tributary to the Delta. Tributary inflow to the Delta at that time was mostly storage releases from federal and state reservoirs to supplement low summer unregulated flow. This controlled inflow was not sufficient to supply the sudden draft placed on the Delta's water supply by the levee break. Saline waters rushed in from Suisun Bay to meet the remaining draft, temporarily interrupting the controlled outflow that had been forming a hydraulic barrier to protect the Delta against salinity intrusion. Both the State Water Project (SWP) and federal Central Valley Project (CVP) immediately reduced exports and increased storage releases to restore the hydraulic barrier. In the western Delta, salinity began an immediate downward trend. But in the central and southern Delta, the flushing effect was less effective, and the saltwater needed to be removed by local and export pumping, causing adverse effects on agricultural and domestic water supplies. (California Department of Water Resources 1982, Bulle-tin 192-82.)

Local reclamation districts are concerned with the cost of maintaining and improving the levee and channel system. A complex array of agencies with planning, regulatory, and permitting authorities over levees makes rehabilitation and maintenance efforts difficult. Regulatory measures that protect endangered species or critical habitat sometimes conflict with and prolong levee rehabilitation and maintenance work, which can further increase the vulnerability of the system. CALFED's role is to reduce the existing conflicts between local agencies responsible for maintenance and regulatory agencies.

Regulatory measures that protect endangered species or critical habitat sometimes conflict with and prolong levee rehabilitation and maintenance work, which can further increase the vulnerability of the system.

1.1 DELTA AND LEVEE BACKGROUND INFORMATION

Prior to human intervention, the Delta consisted of low-lying vegetated wetlands separated by a complex of rivers, channels, and sloughs. Along the waterways were slightly higher over-bank deposits of coarser sediments, commonly referred to as "natural levees."

The Delta was reclaimed in two phases. During the first phase (1850-1880), reclamation projects were small-scale efforts using manpower and horsepower to build levees on top of existing natural levees. In the second phase (from 1880 to the early 1900s), levee building was more aggressive and was accomplished with powerful mechanical equipment. Currently, the Delta includes over 700,000 acres, with 700 miles of meandering waterways and approximately 1,100 miles of levees.

Currently, the Delta includes over 700,000 acres, with 700 miles of meandering waterways and approximately 1,100 miles of levees.

In the early 1900s, the Reclamation Board was created and Congress authorized the CVP. The State Water Resources Development Bond Act was approved in 1960, launching the SWP. SWP facilities include levees, control structures, channel improvements, and appurtenant facilities in the Delta that are used for water conservation, water supply, cross-

Delta water transfers, and flood and salinity controls. Also in 1960, the Sacramento River Flood Control Project was completed by the U.S. Army Corps of Engineers (Corps). This project incorporated and improved flood control for a portion of the Delta. In the 1970s, the California Legislature recognized that the Delta levee system benefits many segments and interests of the public and approved a plan to preserve the Delta levee system. In 1986, the CVP-SWP Coordinated Operation Agreement was initiated and the California Supreme Court confirmed the State Water Resources Control Board's authority and discretion over water rights and water quality issues in the Bay-Delta system, including jurisdiction over the federal CVP.

Since the late 1980s, a flurry of activity has shaped the future of the Delta. The Delta Flood Protection Act of 1988; Environmental Mitigation and Protection Requirements; the Delta Protection Act of 1992; the Central Valley Project Improvement Act (CVPIA); and the Safe, Clean, Reliable Water Supply Act were enacted. In 1994-1995, state and federal agencies entered into the historic Bay-Delta Accord, and the CALFED Bay-Delta Program "to fix the Delta" was initiated.

Table 1 (at the end of the report) provides a chronological summary of events important to the Delta.

1.2 CURRENT DEFICIENCIES - PROBLEM STATEMENTS

The State Reclamation Board (Board) and local agencies have been in partnership to reconstruct Delta levees for over 25 years. Although significant progress has been made in improving Delta levee integrity, several problems remain. If CALFED is to achieve its objectives, these problems must be addressed. This Levee System Integrity Program Plan develops strategies to address the following problems.

Although significant progress has been made in improving Delta levee integrity, several problems remain. If CALFED is to achieve its objectives, these problems must be addressed.

Many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. The existing levee program was intended to improve Delta levees up to the California/Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan (HMP) standard. As of January 1998, 36 of 62 (58%) Delta islands and tracts were in compliance with the HMP standard. Because the HMP standard will not assure success of CALFED objectives, a higher standard is needed.

Funding for levee work is insufficient, inconsistent, and often delayed. Under existing programs, local agencies must finance projects up-front and submit claims for reimbursement. Processing time for claims varies greatly as do reimbursement rates. Because funding is inconsistent, project planning by local agencies is difficult. The time lag from work completion to reimbursement poses financial difficulties for local agencies without the financial resources to provide up-front funds for an extended period. Even with reimbursements, many local districts cannot afford their share of costs under the current cost-sharing arrangements for levee work, without the additional financial burden of proposed levee upgrades.

Dredging to increase channel capacity and to provide material for levee reconstruction and subsidence control has been curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta. Regulatory agencies limit

dredging in the Delta due to water quality and endangered species concerns. Because insufficient data are available to quantify impacts and establish acceptable dredging criteria, agencies regulate dredging activities more conservatively.

Existing emergency response capabilities need to be continuously refined and funding needs to be increased. The existing emergency response system has significantly improved over the past several years; however, the system is limited by insufficient dedicated Delta funding. In addition, improvements in command and control need to be continuously refined.

Levee reconstruction and maintenance sometimes conflicts with management of terrestrial and aquatic habitat resources on or around levees. In general, vegetation on levees results in levee maintenance being more difficult. Stakeholders have voiced concern that activities to control levee and channel vegetation sometimes are delayed because of potential impacts on endangered species habitat. Because local agencies often keep vegetation off of levee slopes to avoid the need to contend with endangered species requirements, potential opportunities for quality habitat are lost. Better strategies are needed to allow quality habitat to flourish on or around levees without hampering levee maintenance and construction.

Obtaining permits for levee work can be difficult and time consuming. Historically, obtaining permits for levee work has been difficult. In 1996, the California Department of Fish and Game (DFG) assumed a more active role in assisting local agencies with the regulatory process. This participation is a significant improvement and should continue. However, other regulatory agencies often lack sufficient resources to issue permits without delays. In addition, disagreements exist between regulatory agencies with overlapping jurisdiction. A more efficient permit coordination process is needed.

Subsidence of portions of some Delta islands threatens levee integrity. Subsidence near some levees in the Delta may adversely affect levee integrity.

Seismic loading threatens Delta levees. Earthquakes pose a catastrophic threat to Delta levees. Seismic forces can cause multiple levee failures in a short period. Such a catastrophe could overwhelm the current emergency response system.

1.3 VISION

The following is a vision of the future that represents successful implementation of the Levee Program along with other CALFED programs.

System-wide levee stability is improved because all levees meet or exceed the Corps' Public Law (PL) 84-99 Delta Specific Standard. The risk of catastrophic failure is significantly lower. The levees are well maintained and regularly inspected. A reliable and steady stream of funding allows for consistent construction and maintenance of Delta levees, creating an industry in the Delta. The increased availability of materials and equipment also aids emergency response capabilities.

A reliable and steady stream of funding allows for consistent construction and maintenance of Delta levees, creating an industry in the Delta. The increased availability of materials and equipment also aids emergency response capabilities.

There is little or no conflict with the ecosystem rehabilitation efforts, and for years there has been a net gain in critical habitat. Once threatened species now thrive, partially in response to levee-associated habitat improvements. Permitting new projects is obtained in weeks because of agency coordination and the availability of a Delta-wide comprehensive

geographic information system (GIS) inventory, which facilitates evaluation of project-related impacts. Even with the addition of waterside habitats, the flood-carrying capacity of the system is better and hydraulic impacts upstream and downstream of the Delta have been beneficial.

Islands of particular state or national importance have been provided with increased flood protection and improvements to their seismic survivability resistance. The ongoing seismic and subsidence risk evaluations and monitoring continually provide feedback that improves levee design and reduces system vulnerability. Emergency response capabilities were improved early in the implementation phase and have proven their worth. The now rare isolated levee breach is closed in weeks, and the risk to water supply and water quality from multiple earthquake-induced failures has been reduced significantly as a result of seismic upgrades and improvements to emergency response capabilities.

1.4 MISSION

The CALFED mission is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. CALFED fundamentally differs from previous efforts because the program seeks to concurrently address ecosystem restoration, water quality, water supply reliability, and levee and channel integrity. The geographic scope of the CALFED problem area consists of the legal Delta, Suisun Bay (extending to the Carquinez Strait), and the Suisun Marsh. The geographic scope of the CALFED solution area includes a much broader area that extends upstream and downstream of the Bay-Delta. The foundation of every CALFED alternative includes six common programs: Ecosystem Restoration, Water Use Efficiency, Water Quality, Water Transfers, Watershed Management, and Levee System Integrity. CALFED also includes two variable programs, Storage and Conveyance. Each of the individual common program elements is a major program on its own, and each element represents a significant investment in and improvement to the Bay-Delta system.

CALFED fundamentally differs from previous efforts because the program seeks to concurrently address ecosystem restoration, water quality, water supply reliability, and levee and channel integrity.

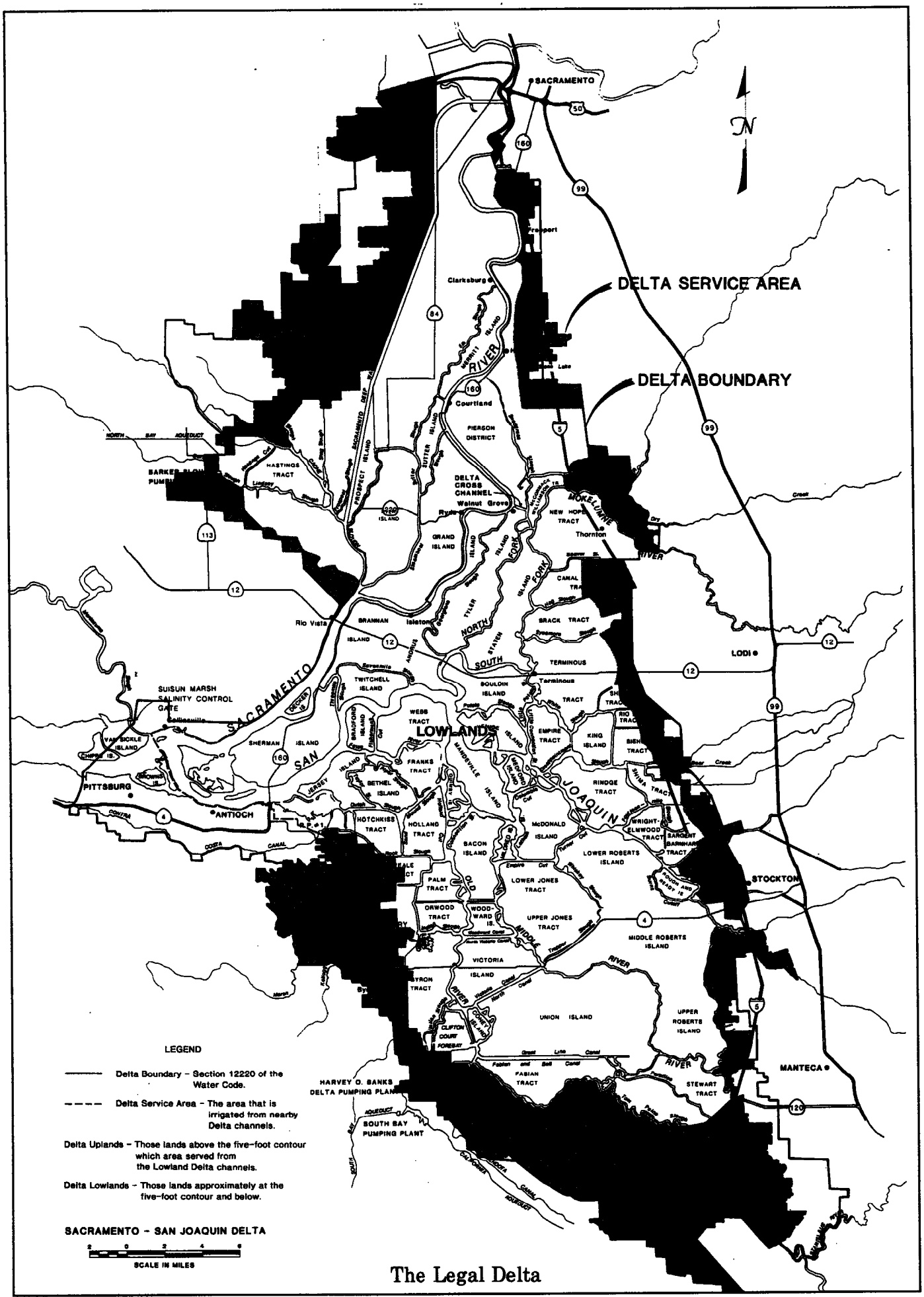
The overall Levee Program objective is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees. Levee Program actions focus primarily on the legal Delta as defined in the Water Code and illustrated in Figure 1. The goal is to provide long-term protection for multiple Delta resources by maintaining and improving the integrity of the Delta levee system. In addition, the Levee Program aims to integrate ecosystem restoration and Delta conveyance actions with levee improvement activities. Improvements in the reliability of water quality will be a natural by-product of the program. Levee Program goals will be achieved through implementation of this Levee System Integrity Program Plan.

The goal is to provide long-term protection for multiple Delta resources by maintaining and improving the integrity of the Delta levee system. The Levee Program aims to integrate ecosystem restoration and Delta conveyance actions with levee improvement activities.

The specific elements of the Levee Program include the:

- Delta Levee Base Level Protection Plan,
- Delta Levee Special Improvement Projects,
- Delta Levee Subsidence Control Plan,
- Delta Levee Emergency Management and Response Plan, and
- Delta Levee Risk Assessment and Risk Management Strategy.

Figure 1


DELTA SERVICE AREA
DELTA BOUNDARY
SACRAMENTO
LODI
STOCKTON
MANTECA
PITTSBURG
ANTIOCH
Rio Vista
Thornton
Courtland
Clarksburg
Walnut Grove
Isleton
Terminous
Tracy
Byron
Tracy
LOWLANDS
SACRAMENTO
SAN JOAQUIN
SUISUN MARSH SALINITY CONTROL GATE
DELTA CROSS CHANNEL
HARVEY O. BANKS DELTA PUMPING PLANT
SOUTH BAY PUMPING PLANT
CLIFTON COURT FOREBAY
MIDDLE RIVER
OLD RIVER
MOKELUMNE RIVER
NORTH BAY AQUEDUCT
CONTRA COSTA CANAL
LEGEND
Delta Boundary - Section 12220 of the Water Code.
Delta Service Area - The area that is irrigated from nearby Delta channels.
Delta Uplands - Those lands above the five-foot contour which area served from the Lowland Delta channels.
Delta Lowlands - Those lands approximately at the five-foot contour and below.
SACRAMENTO - SAN JOAQUIN DELTA
SCALE IN MILES
The Legal Delta